

BADGE-FREE CAN COATING

*Inventors: Christian Vogt and Peter Ambrosi*

Background of the Invention

Metal containers for receiving foods and beverages generally have one or more coatings to prevent contact between the filled product and metal. This is to prevent or minimize corrosion to the metal by the product and any disadvantageous influences on the quality of the product. For producing containers of this type, such as steel or tin cans, metal sheets are used which, prior to their shaping (such as for three-piece can production) or deformation (such as for deep drawing process), are coated with suitable coating compositions. In producing cans for foods and beverages, coatings are required which are extremely flexible and have a low order of toxicity.

Epoxy phenolic type coatings have been applied as lacquers onto metal can stock (e.g., for three-piece cans) and baked to provide coatings having good resistance to aggressive filled products, mechanical performance and metal adhesion. However, many of these incorporate 2,2'-bis(4-hydroxyphenyl) propane-bis(2,3-epoxypropyl)-ether (or homologues thereof), otherwise known as bisphenol-A-diglycidyl-ether or "BADGE" (Bisphenol-A-DiGlycidyl-Ether).

One objective of the present invention is to provide a novel can coating which is substantially free of BADGE (and BADGE-type components). BADGE-containing formulations do not meet approval in some countries for use in food canning. Currently available polyester type coatings, such as those cross-linked with amino-type or isocyanate-type resins, are used on the exterior of three-piece cans, but do not resist processing when in contact with food, or do not comply with food laws, and therefore do not yet provide an alternative coating formulation. In view of the foregoing disadvantages of the prior art, a novel can coating is need which is substantially BADGE-free (and PVC-free as well).

### Summary of the Invention

In surmounting the disadvantages of the prior art, the present invention provides a coating for metal sheet substrates, such as metal cans or metal can stock, which is substantially BADGE-free.

10 Another objective of the present invention to provide a coating which is substantially free of polyvinyl chloride (PVC).

15 A further objective of the invention is to provide metal can coatings that have suitable flexibility and are safe when processed in contact with food. The coatings should be suitable for three-piece cans as well as deep-drawn metal cans.

20 An exemplary coating of the invention comprises (a) a polyester resin (20-50% wt.); (b) a resol resin (1-15% wt.); and (c) a solvent component (35-79% wt.), all weight percentages based on total coating weight, the coating being substantially free of bisphenol-A-diglycidyl-ether and bisphenol-F-diglycidyl ether (e.g., "BADGE" or "BADGE-type" components), and preferably also substantially free of polyvinyl chloride. In further preferred embodiments, the coating comprises a lubricant (0.1-2% wt.) and acid catalyst (0-2% wt.).

25 Further advantages and features of the present invention are discussed hereinafter.

### Detailed Description of the Invention

All weight percentages provided herein are based on the total weight of the coating composition including solvent.

30 As summarized above, exemplary coating compositions of the invention comprise: (a) a polyester resin in the amount of 20-50% wt.; (b) a resol resin in the amount of 1-15% wt. and comprising a condensation product made from a phenol or homologue thereof and formaldehyde; and (c) a solvent in the amount of 35-79% wt., all weight percentages being based on the total weight of said coating, the coating compositions being substantially

5 free of bisphenol-A-diglycidyl-ether ("BADGE") and bisphenol-F-diglycidyl ether (a "BADGE-type" component).

The phrase "substantially free" as used within the context of this application means that the coating compositions of the invention have no BADGE, BADGE-type component, or PVC, or at least no more than a de minimus amount of these components, e.g., less than 0.001% by total wt..

10 An exemplary polyester resin component of the invention comprises (a) trimethylolpropane in the amount of 0.1-10% wt. and more preferably 1-7% wt.; neopentylglycol in the amount of 15-30% wt. and more preferably 20-25% by wt.; at least one other polyol (e.g., ethylene glycol, propylene glycol) 15 in the amount of 5-20% wt. and more preferably 10-15% wt.; phthalic acid (including iso- and tere-) in the amount of 20-60% wt. and more preferably 20-25% wt.; and adipic acid in the amount of 10-35% wt. and more preferably 15-20% wt. A commercially available polyester resin, available from DSM Resins 20 of Zwolle, The Netherlands under the tradename URALAC XP 8481 SN, is believed to be suitable for use as polyester resin component (a) in the present invention.

25 Resol resin component (b) may be characterized as a condensation resin made from a phenol or phenolic homologue (phenol, butyl phenol, cresol, xylenol, Bisphenol A) and formaldehyde. Preferably, the resol resin comprises Bisphenol A, butyl phenol, xylenol, or a mixture thereof, and formaldehyde. Commercially available resol resins believed to be suitable for use in the present invention are available from Vianova Resins, Germany, under the tradename PHENODUR PR 401 and from Deutsche Shell Chemie, Germany, under the tradename EPICURE DX 200.

30 The resins can be solvated in a solvent or solvent mixture, for example, n-butanol and/or butylcellusolve, or other conventional solvents used for can coatings. The resin can be etherified with an alcohol (e.g., butanol) and solvated in the solvent or solvent mixture. Other known solvents that can be used for solvating the polyester and resol resins include aromatic 35 hydrocarbons (e.g., aromatic 100 or aromatic 150), glycolether/glycolether

5 acetate (e.g., methoxypropanol butylcelluloseacetate, methoxypropylacetate), alcohols (e.g., isobutanol, diacetone alkohol), ketons (e.g., methylisobutylketon, isophorone) or esters (e.g., butyl acetate, dibasic esters). In other exemplary coating compositions of the invention, at least two different solvents are used, preferably having different boiling ranges.

10 Preferably, the coating composition further comprises a lubricant which is in a solid form dispersed in solvent. The lubricant may be present in the coating composition in the amount of 0.1-2% wt., and more preferably 0.1-1% wt. Exemplary lubricants may comprise polyethylene (PE), polypropylene (PP), PTFE, lanoline, carnauba wax and petrolatum.

15 Preferably, the lubricant comprises PE, PP or PTFE or a mixture of these.

20 Preferred coating compositions also comprise at least one catalyst, preferably an acidic catalyst, such as sulfonic acid (e.g., paratoluene sulfonic acid and dodecyl benzenesulfonic acid), phosphoric acid and phosphoric acid ester (e.g., phosphoric acid monobutyl ester), in the amount of 0.05-2.0% wt., and more preferably in the amount of 0.05-1.0% wt.

Accordingly, a preferred coating composition of the invention comprises polyester resin (solid) (20-50% wt); resol resin (solid) (1-15% wt); a lubricant (solid) (0.1-2% wt); an acidic catalyst (0-2% wt); and a solvent (35-79% wt), all percentages based on the total weight of the coating composition.

25 The coating may be applied to a metal substrate or metal plate for a can, such as by roller coating or spray coating, or it may be applied by these means to a formed can. Preferred application is by roller coating to the flat metal before formation of the can. Preferred coating layer weights are 2-15 gsm (grams/square meter), and more preferably 3-8 gsm. After application, 30 the coating should be cured at 180°C - 210°C, and more preferably at 190°C - 205°C for 6 to 20 minutes, and more preferably 8-13 minutes.

Example 1

An exemplary can coating composition of the invention may be prepared and applied as follows. A coating batch may be formulated as follows, using a blender that can mix the following components into a sufficiently homogeneous composition. The polyester resin, comprising trimethylolpropane, neopentylglycol, and other polyols, as previously discussed, is preferably added first into the blender in the amount of 40-85% wt and more preferably 69-80% wt (based total weight of coating composition). The polyester resin was URALAC XP 8481 SN (from DSM Resins) which was solvated in a solvent mixture that comprised SOLVESSO 150 and butyl cellosolve (which solvents were used in a 4:1 weight ratio). SOLVESSO 150 aromatic hydrocarbon solvent is available from Exxon Chemical, and is believed to have a boiling range of 186-210°C. Butyl cellosolve is otherwise known as butyl glycole (e.g., ethylene glycol mono butyl ether).

Thus, once the polyester resin is introduced into the blender, then the other components can be introduced thereafter during mixing, as follows:

Preferred Range % (total weight)	More Preferred Range % (total weight)	Component	Description of Component
40-85	60-80	Polyester Resin	URALAC XP 8481 (which is about 50% resin components in Solvesso 150/Butyl Cellosolve 4:1)
4-25 %	6-15 %	Resol Resin	PHENODUR PR 401, 70% in butanol
0-25 %	3-8 %	methoxy propyl acetate	optional additional solvent
0-25 %	3-8 %	butyl cellosolve acetate	optional additional solvent
0-25 %	3-10 %	aromatic hydrocarbon solvent	optional additional solvent (e.g., SOLVESSO 100 from Exxon)
0-5 %	0.5-2.0%	mixture of methoxy propanole and phosphoric acid	optional additional solvent wherein these components are preferably used 4:1
0.5-5.0%	0.8-3.0%	lubricant in solvent	lubricant such as PTFE (solid) can be used if solvated in solvents, e.g., SOLVESSO 100 and butyl cellosolve in 1:1:1 ratio

5        Exemplary lubricants which are suitable for use in the present  
invention are PTFE (polytetrafluoroethylene) modified with polyethylene  
wax, micronised (e.g., specially fine), and are available from Lanco Wax under  
the designations "TF 1780 EF." Also available from Lanco Wax is a  
10      polyethylene/polypropylene lubricant under the designation "PP 1350 FF"  
which may also be suitable in the present invention. The lubricant, which is  
in solid form, should be mixed with a suitable solvent or solvents, such as  
SOLVESSO 100 (an hydrocarbon based solvent from Exxon) and butyl  
cellosolve, in amounts sufficient to prevent agglomeration of the lubricant in  
the mixture.

15      Once a homogeneous mixture of the coating components is obtained,  
this may be roller coated onto steel or aluminum can stock, for example, and  
baked at about 200°C for preferably 12-15 minutes. A BADGE-free can  
coating is thus obtained.

20      The foregoing discussion is provided by way of illustration only and is  
not intended to limit the scope of the invention as set forth in the claims.

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